Tuberculosis in Alberta Surveillance Report

2013 to 2022

Alberta

Primary and Preventative Health Services, Government of Alberta
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Acronyms

- AMR – Antimicrobial resistance
- CFR – Case fatality rate
- CNS – Central nervous system
- HIV – Human Immunodeficiency Virus
- IHDA – Interactive Health Data Application
- IQR – Interquartile range
- LTBI – Latent tuberculosis infection
- PHAC – Public Health Agency of Canada
- TB – Tuberculosis
- WHO – World Health Organization

Definitions

- **Antimicrobial resistance** (AMR) – Also known as antibiotic resistance, a pathogen's ability to resist medications used for its treatment [1]
- **Case fatality rate** – The number of people diagnosed with tuberculosis who end up dying from tuberculosis. This is reported as tuberculosis related deaths per 100 cases. A tuberculosis-related death is defined as a death where tuberculosis is the direct cause or a contributing factor
- **Case rate** – The number of people diagnosed with tuberculosis in a population. This is reported as cases per 100,000 population and can be calculated for different ages, population groups, geographies or time frames
- **First Nations** – Persons who self-identify as First Nations
- **Human Immunodeficiency Virus** (HIV) – A virus that attacks the immune system of infected individuals. Refers both to the virus and the infection [2]
- **Individuals born outside of Canada** – Persons whose place of birth is outside of Canada
- **Interquartile range** (IQR) – A measure of spread used with the median; calculated as the difference between the first and third quartiles and indicates how clustered observations are around the median value [3]. A small IQR indicates that the data are clustered close to the median
- **Isolate** – A *Mycobacterium tuberculosis* complex species sample that comes from a person with a tuberculosis infection. These samples are collected from a subset of reported cases and are used to identify unique traits (e.g. antimicrobial resistance)
- **Median** – The middle value of a set of data that has been put into rank order. 50% of values will be above and below it [4]
- **Métis** – Persons who self-identify as Métis
- ***Mycobacterium tuberculosis* complex** – Species of *Mycobacterium* bacteria that cause TB in humans and animals, excluding the Bacillus Calmette-Guérin vaccine-derived strains
- **Non-Indigenous Canadian-born** – Persons born in Canada who do not identify as First Nations, Métis, or Inuit
- **Range** – The minimum and maximum values of a set of measurements [4]
- **Sex** – An individual's sex at birth. Presently, male or female
- **Treatment completion rate** – The number of people who successfully completed the tuberculosis treatment regimen out of the total number of cases. This is reported as a per cent of the number of cases diagnosed with tuberculosis. Successful completion includes people who have completed treatment and people who have been cured. More information about treatment completion can be found in the data notes section under [Outcome Category Aggregation]

Epidemiological Summary

From 2013 to 2022, the rate of tuberculosis (TB) was stable in Alberta and across other Canadian provinces and territories. In Alberta, TB diagnoses are primarily among individuals born outside of Canada. However, a small number of cases continue to emerge among individuals who are Canadian-born, particularly in vulnerable populations. New approaches are needed to progress towards the elimination of TB in Alberta.

- In 2022, the rate of TB in Alberta was 5.4 cases per 100,000 population (244 cases)
- In 2022, Edmonton and Calgary Zone had the highest rates of TB in Alberta at 7.2 and 5.9 cases per 100,000 population, respectively

Between 2013 and 2022

- Alberta case rates ranged from a minimum of 4.7 per 100,000 population (188 cases) in 2013 to 5.7 cases per 100,000 population (251 cases) in 2020
- Individuals aged 35 to 64 years old accounted for 43.9% of all cases. However, the highest median age-specific case rate was observed in people aged 65 years and over, with a median rate of 8.6 cases per 100,000 population
- Males accounted for most of the cases (55.0%) and had a higher median case rate compared to females, at 5.7 and 4.8 cases per 100,000 population, respectively
- Most cases were diagnosed in individuals born outside of Canada (87.9%)
- The most common primary diagnostic site was pulmonary (55.7%) followed by the peripheral lymph nodes (17.0%)
- Most cases were tested for HIV (98.2%), and 2.6% of individuals who were tested were HIV-positive
- Of the total cases reported, 84.8% were culture positive
  - Of culture positive cases with antimicrobial resistant (AMR) data, 10.6% were resistant to at least one first-line antimicrobial (excluding flouroquinolone mono-resistance)
  - The most common resistance types were isoniazid mono-resistance (58.9%), multidrug resistance (12.3%), and pyrazinamide mono-resistance (11.9%)
  - Most AMR isolates (92.7%) were detected in individuals born outside of Canada
- The treatment completion rate was 88.5%
  - The most common reasons for non-completion of treatment were death from any cause before or during treatment (42.3%) and the transfer of the case outside of Alberta for follow-up care (30.3%)
- The TB-related case fatality rate (CFR) was 4.1 deaths per 100 cases

This report describes key epidemiological trends of active TB diagnosed in Alberta from 2013 to 2022 and includes an overview of the geographic distribution of cases, demographics, disease characteristics and outcomes. Five zones (Edmonton, Calgary, Central, North and South) are used in this report to provide greater insights into geographical differences in cases. Visit the following link for more details on each health zone.

Introduction

Tuberculosis is a disease caused by the *Mycobacterium tuberculosis* complex. Infections with TB can be active or latent. In an active infection, TB bacteria reproduce and cause symptoms in the infected person. Common symptoms include a lingering cough, chest pain, fatigue, weight loss, suppressed appetite, chills, fever and/or night sweats [5]. Active TB commonly affects the lungs (pulmonary TB) and can also affect other locations in the body like the peripheral lymph nodes, gastrointestinal tract or bones and joints. Person-to-person transmission occurs through inhaling droplets emitted through coughing or sneezing by an individual with active pulmonary TB [6]. About 5% of individuals that contract TB progress to active TB within two years post-infection [7].

In a latent TB infection (LTBI), an infected person's immune system suppresses the TB bacteria [8]. Persons with LTBI are asymptomatic and cannot spread the infection [6], [8]. About 5 to 10% of people with LTBI will progress to active TB at some point in their life [9]. Progression to active TB is complex and typically involves suppression of a person's immune system due to aging, chronic diseases, co-infection with human immunodeficiency virus (HIV) or a combination of these factors [8], [9]. LTBI can be treated before it progresses to active TB.

Great strides have been made in the past 100 years in the prevention and treatment of TB through improved living conditions, nutrition and more effective medications [11]. Canada has one of the lowest rates of TB globally; however, progress on reducing the rate of TB has plateaued since the 1990s [11], [12], [13]. Globally, TB rates in some countries remain high and new challenges are emerging due to the increasing prevalence of antimicrobial resistance (AMR) [14]. In Canada, AMR TB infections are relatively rare, and most are diagnosed in individuals born in countries where AMR TB is more common [12], [14].

Indigenous peoples in Canada are disproportionately impacted by TB, with rates of disease ranging from 71 to 455 times higher compared to non-Indigenous Canadian-born individuals [9]. Inequities in Indigenous communities from the past and ongoing impacts of colonization have resulted in conditions that contribute to LTBI progression to active TB and the spread of TB from person-to-person [9]. Inequitable access to culturally competent care in remote communities, food insecurity and inadequate or overcrowded housing are frequently identified as factors limiting progress towards TB elimination in these communities [9], [15].

In Alberta, the World Health Organization (WHO) Framework towards the goal of eliminating TB in low-incidence countries guides TB control [10]. The Canadian targets are a rate of 10 active cases per 1,000,000 population by 2035 to reduce active TB and 1 active case per 1,000,000 population by 2050 to eliminate TB [16]. Alberta's objectives to achieve these targets are to [10]:

- Reduce the rate of active TB in Alberta
- Prevent the onward transmission of TB
- Prevent the development of active TB in those with LTBI using safe and effective therapies
- Promptly identify patients with active TB and ensure the safe and effective completion of treatment
- Ongoing epidemiological surveillance of TB

Methods

Data Sources

Case data

Active TB cases are reported to Primary and Preventative Health Services by Alberta Health Services Tuberculosis Services. The information collected is based on the national case report form created by the Public Health Agency of Canada (PHAC) [17], [18]. Data on TB cases diagnosed between 2013 to 2022 were extracted from the Communicable Disease Reporting System for this report.

Population Denominators

For the years from 2013 to 2022, mid-year population estimates (as of June 30 of each year) for geography (Alberta and zones), First Nations people, sex and age were used in the calculation of the rate of TB. These estimates are available on the Interactive Health Data Application (IHDA).

For the calculation of the rate of TB among the "Canadian-born individuals" (Indigenous and non-Indigenous) and "individuals born outside of Canada", for 2016 and 2021, population estimates from the 2016 and 2021 censuses were utilized for the denominator of the rate calculation.

Calculation of Median Values

Unless otherwise stated, the medians, ranges and interquartile ranges (IQR) are calculated from the annual values for the reporting period (e.g. annual rates and annual percentages).

Considerations when interpreting surveillance data

- Alberta population estimates exclude individuals in federal correctional facilities and those who have not registered for Alberta healthcare insurance. Cases identified in these groups are reported by Alberta Health Services Tuberculosis Services to Primary and Preventative Health Services. This may result in a small overestimation of TB rates because cases among those in correctional facilities are included in the numerator, but these individuals are not included in population estimates. For more information, please refer to the data notes section on the IHDA
- Alberta-specific denominators for Canadian-born individuals and individuals born outside of Canada are unavailable outside of the census years of 2016 and 2021
- TB outcomes are reported with a lag of one year due to the case follow-up required prior to reporting
- Small numbers can cause fluctuations in rates and should be interpreted with caution
- The latest PHAC national report, *Tuberculosis in Canada: Epidemiological update 2022*, was used to compare Alberta to other Canadian provinces and territories as well as national data. All data in this report is for the reporting period of 2013 to 2022 except for TB outcomes which are reported from 2012 to 2021 [13]. National data may not include all provinces and territories depending on which metric is being reported
- In the case of multiple diagnostic sites, the primary diagnostic site is selected based on the hierarchy defined by PHAC

Tuberculosis Cases

Alberta - Cases and Rates

The TB rate in Alberta peaked in the 1950s, prior to the availability of effective therapies, before declining in subsequent decades (**Figure 1**). From 1990 onwards, rates in Alberta have remained stable relative to the preceding decades (**Figure 1 and 2**). Between 2013 and 2022, a total of 2,277 cases were diagnosed in Alberta. During this time, the Alberta median rate was 5.3 cases per 100,000 population (IQR: 0.4 per 100,000 population, Range: 4.7 - 5.7 per 100,000 population), with the lowest annual rate in 2013 and the highest in 2020. This is higher than the national median rate of 4.8 cases per 100,000 population (IQR: 0.3 per 100,000 population, Range: 4.6 - 5.1 per 100,000) (**Table 1**). Of the four Western provinces (British Columbia, Alberta, Saskatchewan and Manitoba), Alberta had the lowest median rate (**Table 1**). In 2022, 244 cases were reported in Alberta and the TB rate was 5.4 cases per 100,000 population (**Table 3**).

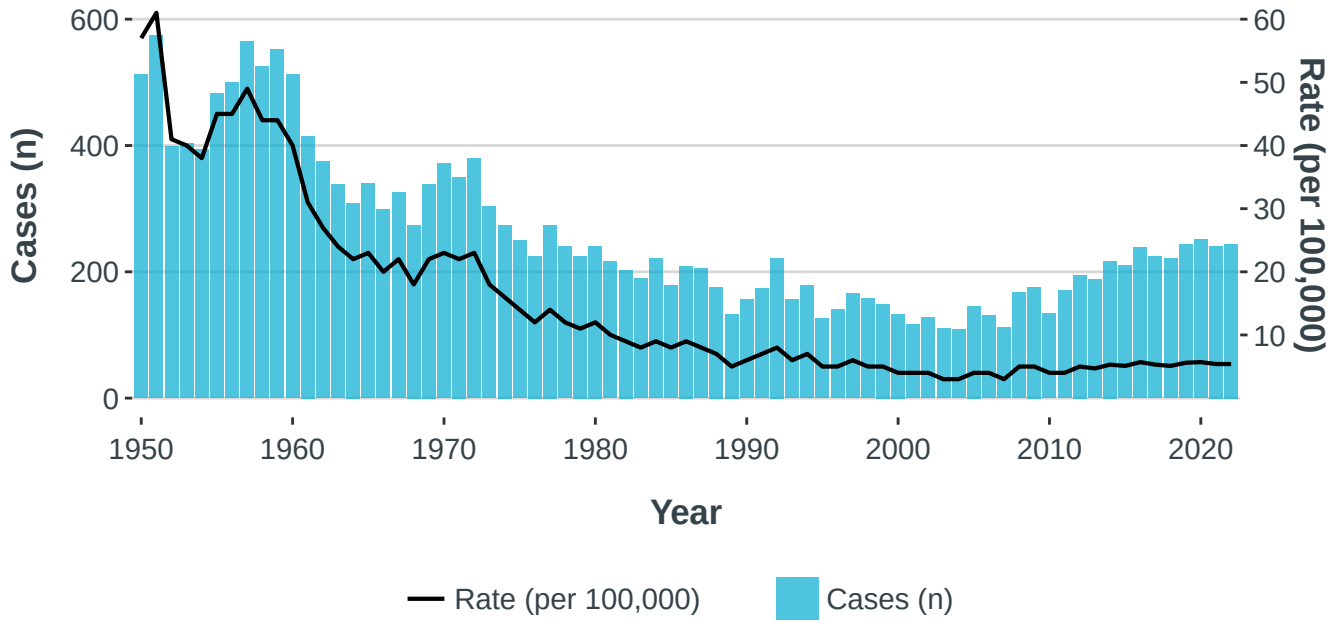


Figure 1. Annual count and rate (per 100,000 population) of TB cases in Alberta (1950 - 2022)

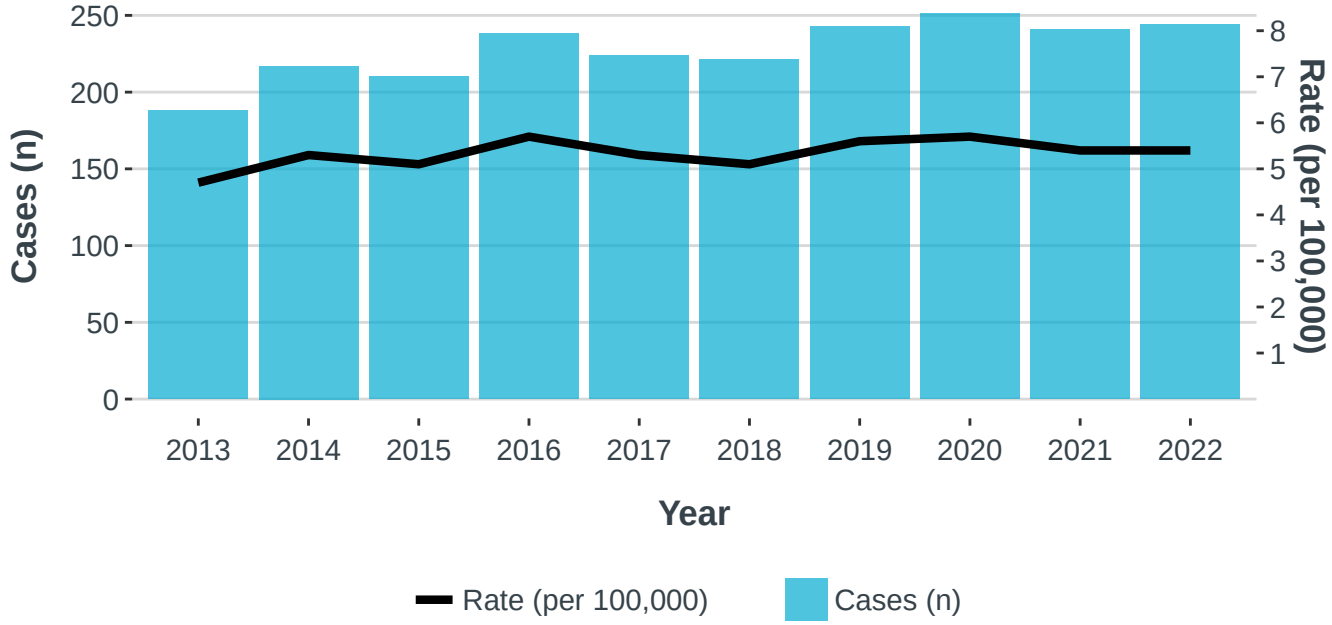


Figure 2. Annual count and rate (per 100,000 population) of all TB cases in Alberta (2013 - 2022)

Table 1. Rate (per 100,000 population) of TB cases across Canadian provincial and territorial jurisdictions (2013 - 2022)

	Rate (per 100,000 population)			
Jurisdiction	Median	Interquartile Range	Minimum	Maximum
Nunavut	145.2	50.3	86.8	269.0
Manitoba	12.6	2.9	9.2	15.3
Northwest Territories	8.9	3.9	6.6	15.4
Saskatchewan	8.0	1.5	5.6	12.1
British Columbia	5.8	0.3	4.9	6.0
Alberta	5.3	0.4	4.7	5.7
Ontario	4.7	0.2	4.3	5.1
Yukon	4.0	5.4	2.3	20.2
Quebec	3.0	0.4	2.5	3.4
Newfoundland	2.6	2.0	1.3	6.2
Prince Edward Island	1.9	1.3	0.0	2.7
New Brunswick	1.0	0.6	0.4	2.0
Nova Scotia	0.9	0.5	0.3	1.7
Canada	**4.8**	**0.3**	**4.6**	**5.1**

Note: National data were retrieved from the 2022 national TB reporting [13]; Alberta numbers reflects most up to date data used in this report

Geographic Distribution

Cases were primarily identified in the Edmonton and Calgary Zones, accounting for 83.4% of all cases diagnosed between 2013 and 2022 (**Table 2**, **Figure 3**). TB rates remained relatively stable over the reporting period within zones, but Edmonton and Calgary Zones had a consistently higher rate of TB when compared to the South, Central and North Zones (**Table 3**).

There was a sharp increase in the TB rate in the North and South Zones in 2016 (**Figure 4**). The increase in the North Zone was linked to an outbreak among the homeless population in the city of Fort McMurray [19]. A similar peak in rates was observed in the South Zone in 2016. However, there was no clear cause for this sudden increase. In 2022, Edmonton Zone had the highest count of TB cases (107 cases) and rate (7.2 per 100,000 population) followed by the Calgary, North, South and Central Zones (**Table 3**).

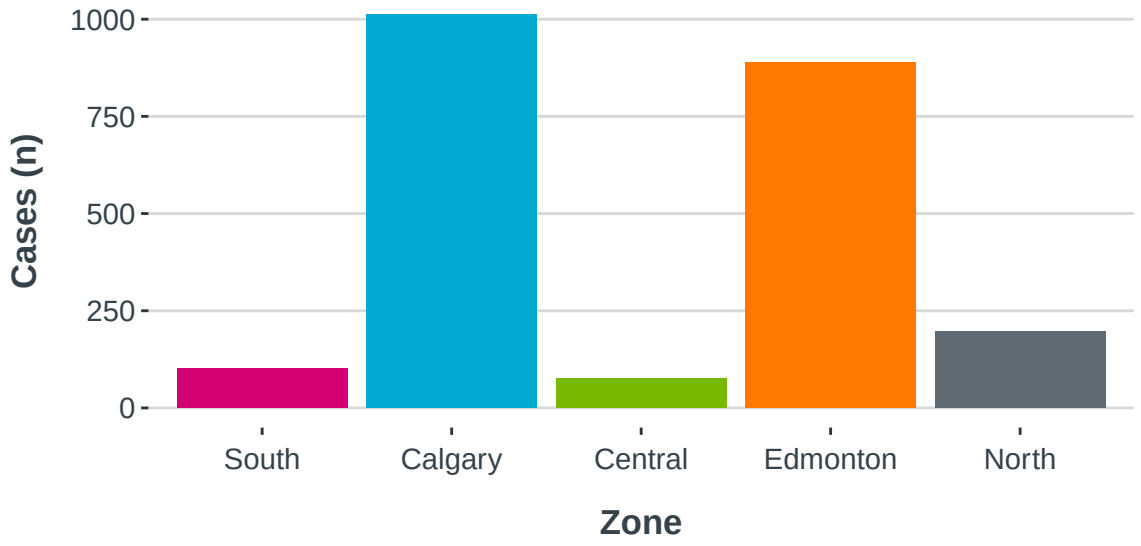


Figure 3. Count of TB cases by zone (2013 - 2022)

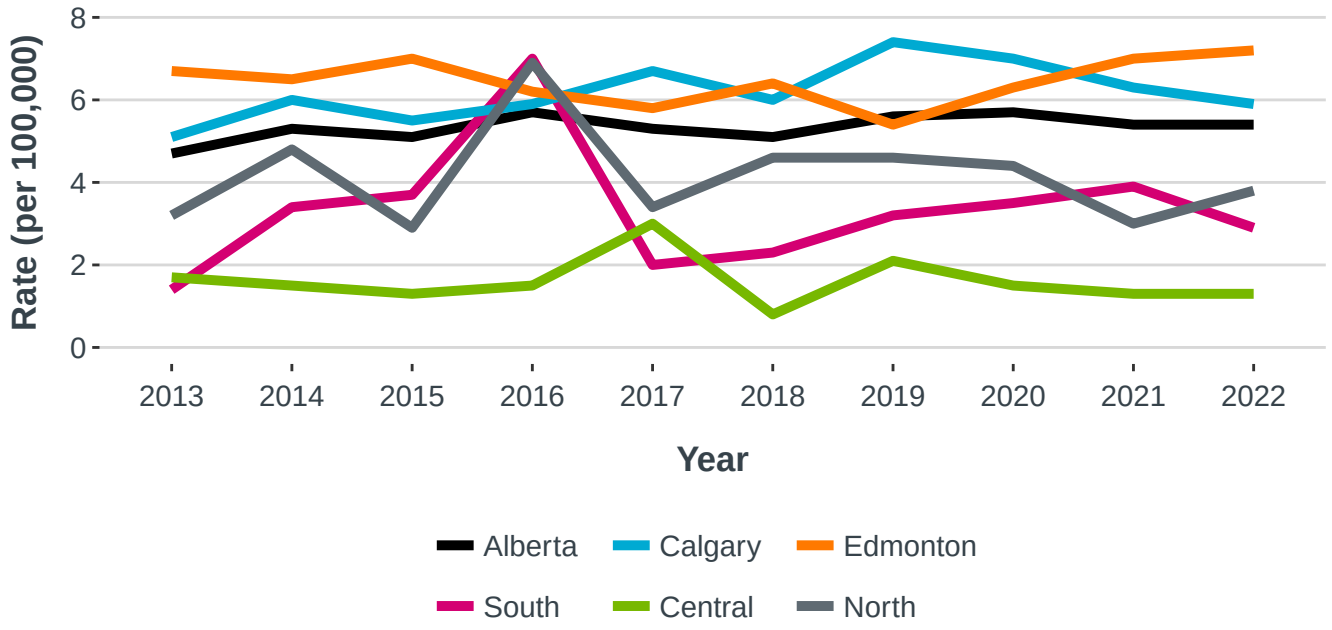


Figure 4. Rate of TB cases (per 100,000 population) by year, zone and provincially (2013 - 2022)

Table 2. Count and per cent of TB cases by zone and provincially (2013 - 2022)

	Cases	
Zone	Count	Per cent
Calgary	1011	44.4
Central	75	3.3
Edmonton	889	39.0
North	198	8.7
South	101	4.4
Unknown	3	0.1
Alberta	**2277**	**100.0**

Table 3. Count and rate of TB cases (per 100,000 population) by year, zone and provincially (2013 - 2022)

	Zones											
	Alberta		Calgary		Central		Edmonton		North		South	
Year	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate	Cases	Rate
2013	188	4.7	77	5.1	8	1.7	84	6.7	15	3.2	4	1.4
2014	217	5.3	93	6.0	7	1.5	84	6.5	23	4.8	10	3.4
2015	210	5.1	86	5.5	6	1.3	93	7.0	14	2.9	11	3.7
2016	238	5.7	94	5.9	7	1.5	83	6.2	33	6.9	21	7.0
2017	224	5.3	108	6.7	14	3.0	80	5.8	16	3.4	6	2.0
2018	221	5.1	98	6.0	4	0.8	89	6.4	22	4.6	7	2.3
2019	243	5.6	124	7.4	10	2.1	77	5.4	22	4.6	10	3.2
2020	251	5.7	119	7.0	7	1.5	91	6.3	21	4.4	11	3.5
2021	241	5.4	108	6.3	6	1.3	101	7.0	14	3.0	12	3.9
2022	244	5.4	104	5.9	6	1.3	107	7.2	18	3.8	9	2.9

Note: The Alberta total includes records where the zone of residence is unknown.

Case Demographics

Age and Sex

The overall median case age was 42 years between 2013 and 2022 (IQR: 32 years, Range: 0 - 101 years). Per year, the median age was stable between 2013 and 2021, ranging between a median of 39 and 43 years, but increased sharply in 2022 to 49 years (IQR: 31 years, Range: 3 - 101 years). No difference in the overall median age was observed between population groups, sexes or zones.

Between 2013 and 2022, 43.9% of cases were in the 35 to 64 year age group, followed by the 15 to 34 years (31.9%), 65 years and over (21.3%), 5 to 14 years (1.5%) and the under 5 years age group (1.4%) (**Figure 5**). The per cent of cases in some age groupings changed year-to-year between 2013 and 2022. For example, the per cent of cases in the 35 to 64 years age group increased from 41.0% in 2013 to 50.8% of cases in 2022 (**Figure 6 – top**). Conversely, the per cent of cases in the under 5 years and 5 to 14 years age group decreased, from 3.2% and 4.8% in 2013 to 0.8% and 0.8% in 2022, respectively (**Figure 6 – top**). The per cent of cases in the 15 to 34 years and 65 years and over age groups remained relatively unchanged from 2013 to 2022 (**Figure 6 – top**).

For each year of reporting, the largest percentage of cases was in 35 to 64 year age group between 2013 and 2022. However, for this time frame, the highest TB rate was consistently observed in the 65 years and over age group with a median rate of 8.6 cases per 100,000 population (IQR: 1.5 cases per 100,000 population, Range: 7.2 - 11.3 cases per 100,000 population) (**Figure 6 – bottom**). The TB rate for the 65 years and over age group increased from 2013 to 2017, peaking at 11.3 cases per 100,000 population, before decreasing and stabilizing between 2018 and 2022 (**Figure 6 – bottom**). The lowest TB rate was observed in the under 5 years and 5 to 14 years age groups, with median rates of 1.5 per 100,000 population (IQR: 1.0 per 100,000 population, Range: 0.4 - 2.3 per 100,000 population) and 0.5 cases per 100,000 population (IQR: 0.4 per 100,000 population, Range: 0.3 - 0.9 per 100,000 population), respectively. The TB rate for both age groups decreased from 2.3 and 1.9 cases per 100,000 population in 2013 to 0.8 and 0.3 cases per 100,000 population in 2022 for the under 5 years and 5 to 14 years age groups, respectively (**Figure 6 - bottom**). The TB rate for the 35 to 64 years age group increased from 4.8 cases per 100,000 population in 2013 to 6.8 cases per 100,000 population in 2022 (**Figure 6 – bottom**). The 15 to 34 years age group remained stable from the beginning to the end of the reporting period (**Figure 6 – bottom**).

Between 2013 and 2022, males comprised 55.0% of cases reported. Each year, annual rates for males were higher than females with a median rate of 5.7 cases per 100,000 males (IQR: 0.7 per 100,000 males, Range: 4.9 - 6.8 per 100,000 males) compared to 4.8 cases per 100,000 females (IQR: 0.5 per 100,000 females, Range: 4.4 - 5.3 per 100,000 females). By age, males were the majority of cases in all but the 5 to 14 year age group (**Figure 7**). This higher rate of TB among males in Alberta is consistent with what has been reported in other Canadian jurisdictions [13]. Detailed annual case numbers for Alberta by age and sex are available in the **Appendix Table 1**.

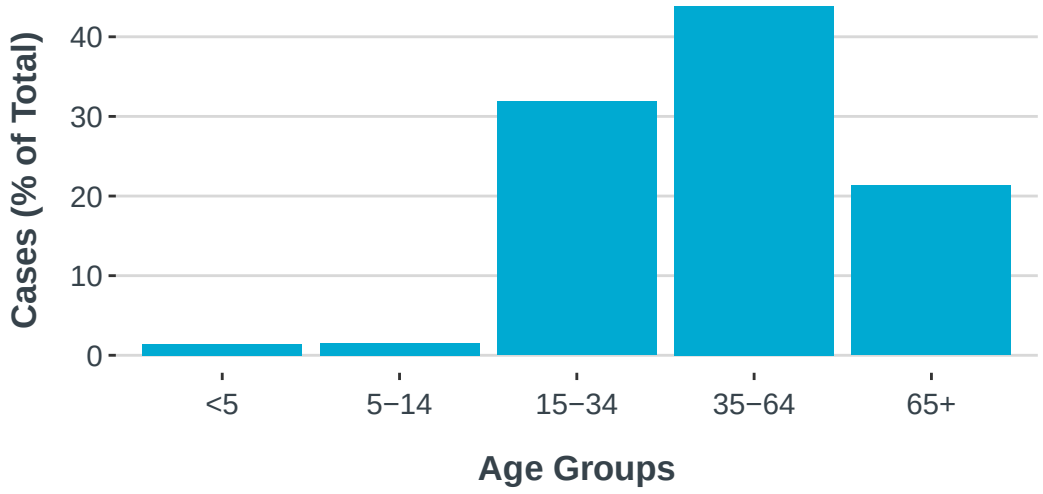


Figure 5. Per cent of TB cases by age group (2013 - 2022)

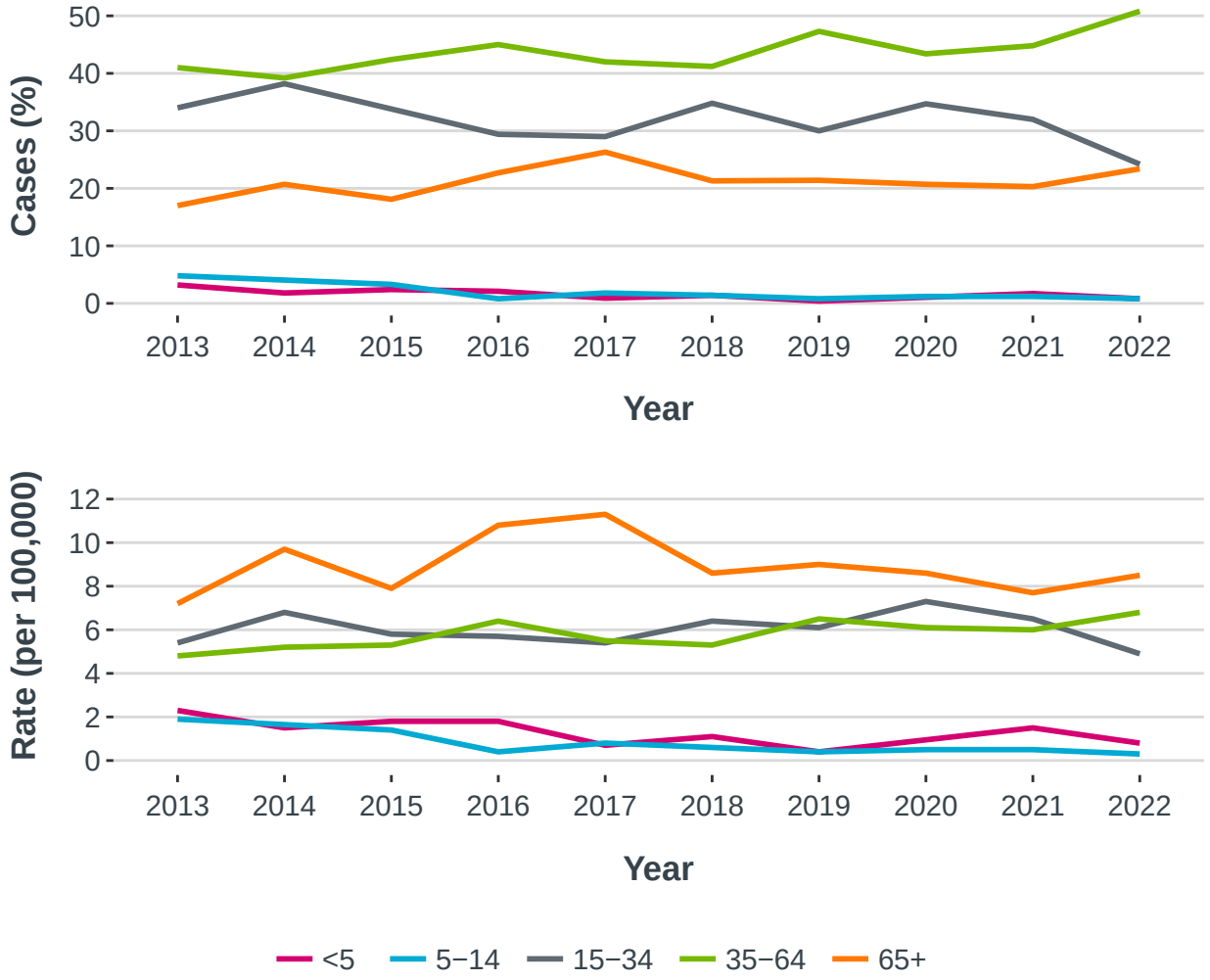


Figure 6. Per cent (*top*) and rate (per 100,000 population) (*bottom*) of TB cases by age group and year (2013 - 2022)

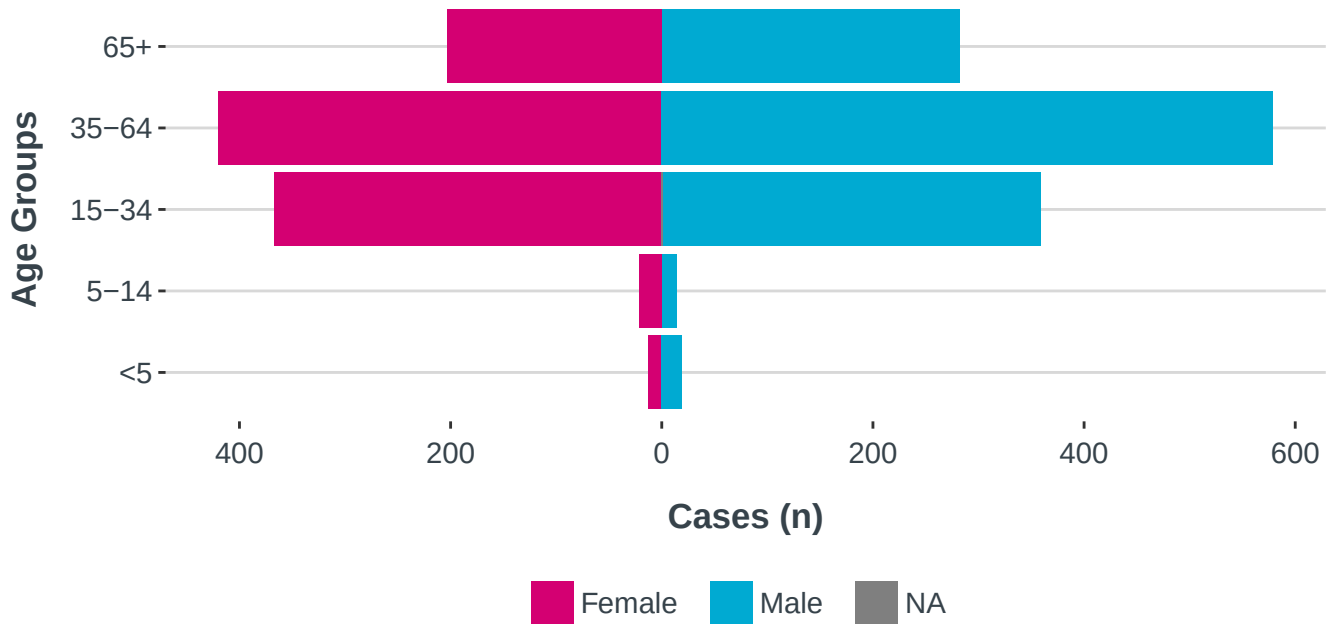


Figure 7. TB cases by age group and sex (2013 - 2022)

Population Group

Individuals born outside of Canada comprised 87.9% of total cases between 2013 and 2022 (**Table 4**). The per cent of cases diagnosed in individuals born outside of Canada increased from 85.1% in 2013 to 93.0% in 2022 (**Figure 8**), which was higher than the national per cent of cases diagnosed in individuals born outside of Canada in 2022 (76.2%) [13]. Among TB cases in Alberta, the five most common birth countries for individuals born outside of Canada were the Philippines, India, Ethiopia, Somalia and Vietnam (**Table 5**). Although the most common birth countries varied year-to-year, the Philippines and India consistently ranked highest; accounting for more than 50.0% of cases born outside of Canada (**Table 5**).

First Nations peoples accounted for 5.8% of total cases between 2013 and 2022 (**Table 4**). An increasing trend in the per cent of cases diagnosed in First Nations peoples was observed, rising from 6.4% in 2013 to 8.4% in 2016. This was followed by a decreasing trend to 4.1% in 2022 (**Figure 8**), which was lower than the national per cent of cases diagnosed in First Nations peoples in 2022 (11.3%) [13]. Between 2013 and 2022, Métis people accounted for only 0.7% of cases and no trend was observed over the reporting period (**Table 4, Figure 8**). Non-Indigenous Canadian-born individuals accounted for 5.4% of cases (**Table 4**) and an overall decreasing trend was observed from 6.4% in 2013 to 2.9% in 2022 (**Figure 8**). Between 2013 and 2022, for First Nations peoples, 47.4% of TB cases resided on a reserve at the time of diagnosis (**Table 6**).

Calculation of the rate of TB for the different population groups was only possible for the census years of 2016 and 2021 and could not be done for Métis peoples. In 2016, the TB rate in each population group may be higher than expected due to an outbreak in Fort McMurray. For individuals born outside of Canada, the rate of TB was similar between years with 21.0 cases per 100,000 population in 2016 and 20.1 cases per 100,000 population in 2021. For First Nations peoples, the rate of TB decreased was 12.2 cases per 100,000 population in 2016 and 6.6 cases per 100,000 population in 2021. The rate of TB in Canadian-born individuals (includes non-Indigenous individuals, First Nations peoples and Métis peoples) was 1.3 cases per 100,000 population in 2016 and 0.8 cases per 100,000 population in 2021. A yearly count of cases by population group is available in **Appendix Table 2.**

Table 4. Count of TB cases by population group (2013 - 2022)

	Cases	
Population group	Count	Per cent
First Nations	133	5.8
Individuals born outside of Canada	2002	87.9
Métis	17	0.7
Non-Indigenous Canadian-born	123	5.4
Unknown	2	0.1

Note: The data in this report that pertain to First Nations or Métis populations living in Alberta were included in collaboration with provincial and regional First Nations and Métis Health Directors and the Alberta First Nations Information Governance Center prior to publication.

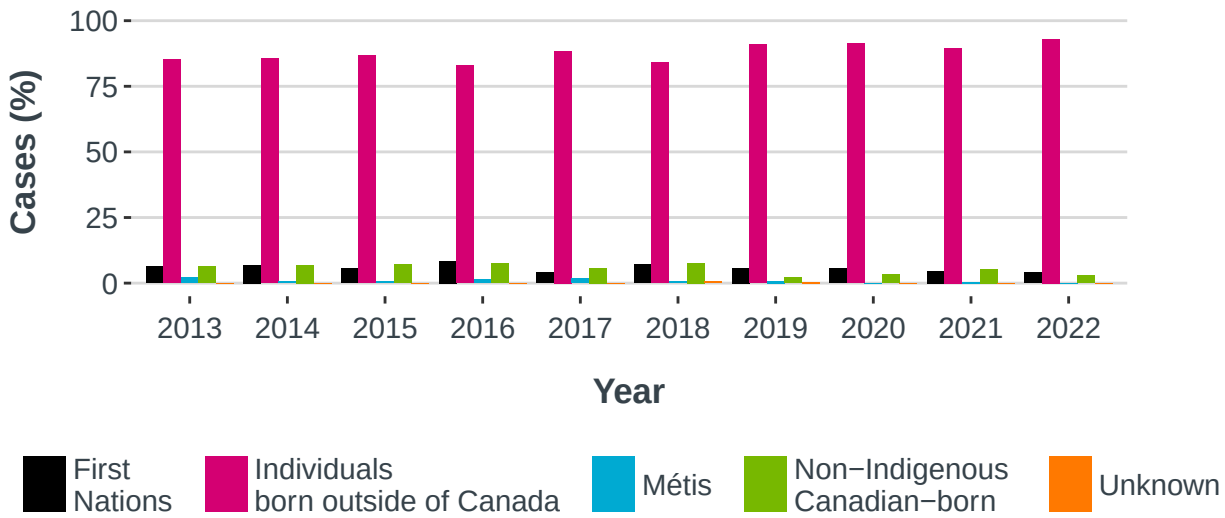


Figure 8. Per cent of TB cases by population group and year (2013 - 2022)

Table 5. Per cent and count of TB cases born outside of Canada by top five countries of birth (2013 - 2022)

	Cases	
Country of Birth	Count	Per cent
Philippines	667	33.3
India	394	19.7
Ethiopia	125	6.2
Somalia	102	5.1
Vietnam	87	4.3

Note: Includes only cases born outside of Canada. A total of 2 records had an unknown country of birth

Table 6. Per cent and count of First Nations TB cases residing on or off reserve (2013 - 2022)

	Persons with TB	
First Nation - lives on reserve	Cases	Per cent
Yes	63	47.4
No	69	51.9
Unknown	1	0.8
Total	**133**	**100.0**

Note: Includes only persons who self-identified as First Nations people. The data in this report that pertain to First Nations or Métis populations living in Alberta were included in collaboration with provincial and regional First Nations and Métis Health Directors and the Alberta First Nations Information Governance Center prior to publication.

Disease Characteristics

Primary Diagnostic Site

From 2013 to 2022, respiratory TB was the most common primary diagnostic site (65.6%), while non-respiratory TB accounted for 34.4% (Table 7). Among respiratory TB cases, pulmonary TB was the most prevalent (84.9%). The most common non-respiratory diagnostic site was the peripheral lymph nodes (49.2%). From 2013 to 2022, primary TB was the most frequent diagnosis in children under 5 years (68.8% of cases) and those aged 5 to 14 years (40.0% of cases). Pulmonary TB was the predominant primary diagnostic site across all population groups. Among Canadian-born individuals, 65.2% of TB cases were pulmonary, a higher per cent than among individuals born outside of Canada (54.3%). Non-respiratory TB was more common in individuals born outside of Canada (36.8%) when compared to Canadian-born individuals (17.6%).

Table 7. Count and per cent of TB cases by primary diagnostic (2013 - 2022)

	Cases	
Primary Infection Site	Count	Per cent
Respiratory TB		
Primary	52	2.3
Pulmonary	1268	55.7
Other respiratory	173	7.6
Respiratory total	**1493**	**65.6**
Non-respiratory TB		
Miliary	38	1.7
CNS	47	2.1
Peripheral lymph nodes	386	17.0
Other non-respiratory	313	13.7
Non-respiratory total	**784**	**34.4**
All sites		
Total	**2277**	**100.0**

Note: CNS = central nervous system

HIV Coinfection

Between 2013 and 2022, 98.2% of cases were tested for HIV (**Table 8**). A small per cent (1.0% of all cases) either refused an HIV test or were not offered a test by clinical staff after their TB diagnosis (**Table 8**). The number of TB cases refusing testing decreased from 2014 to 2022 and overall accounted for only 0.4% of all cases (**Figure 9** and **Table 8**). Testing was not offered for 0.6% of all cases (**Table 8**). In 2021 and 2022, all cases with a known testing status were offered a test, and none were refused. These were the only years in the reporting period when this occurred (**Figure 9**).

Of those tested for HIV, 2.6% were HIV-positive. A decreasing trend in the per cent of cases that were HIV-positive was observed from a high of 6.1% in 2014 to 0.4% in 2022 (**Figure 9**). Annual HIV testing numbers for Alberta can be found in **Appendix Table 3**. A comparison of HIV testing coverage and HIV positivity to national data was not possible due to incompleteness in the reporting of these data to PHAC [13]. Between 2013 and 2022, most HIV positive cases were identified in the 35 to 64 years age group (77.6%). The 35 to 64 years age group had the highest HIV-positivity (4.6%) followed by the 15 to 34 years (1.7%) and the 65 years and over (0.2%) age groups. No HIV positive cases were identified in the under 5 years and 5 to 14 years age groups.

Table 8. Count and per cent of TB cases by HIV testing status (2013 - 2022)

	Cases	
HIV Test Status	Count	Per cent
Positive	58	2.5
Negative	2179	95.7
Refused	10	0.4
Not Offered	14	0.6
Unknown	16	0.7

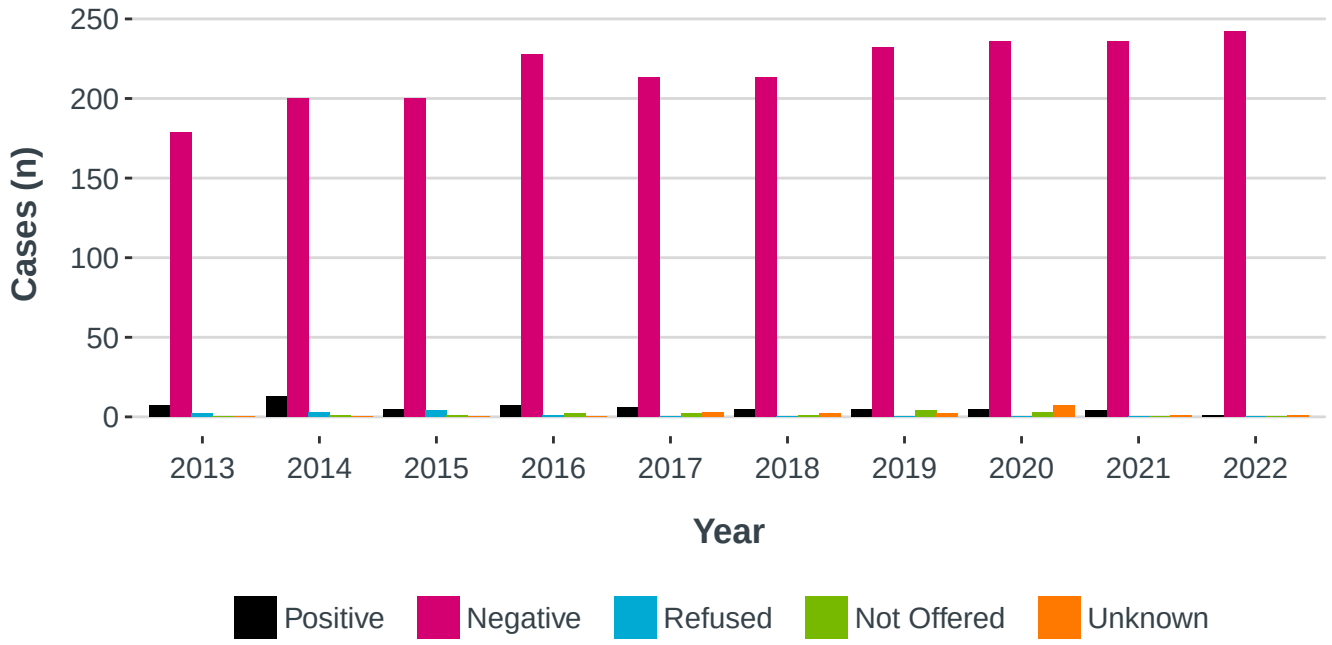
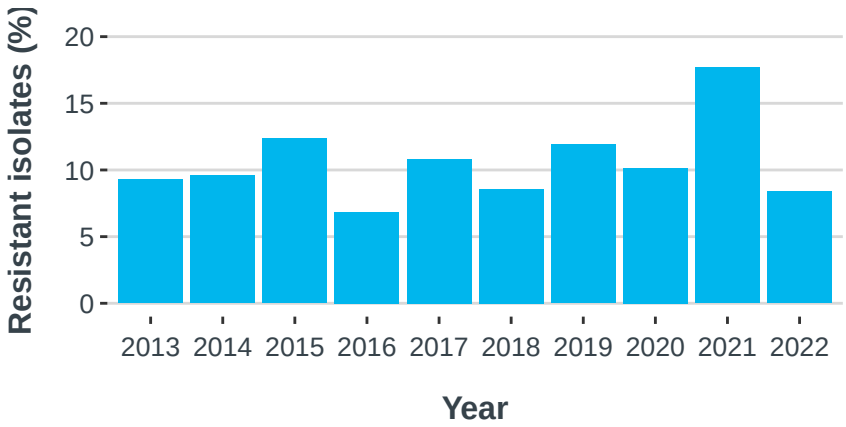


Figure 9. Count of TB cases by HIV testing status and year (2013 - 2022)

Antimicrobial Resistance

Between 2013 and 2022, there was no trend in the percentage of isolates that were resistant to at least one first-line antimicrobial (pyrazinamide, ethambutol, isoniazid or rifampin) (**Figure 10 – top**). The patterns of AMR also remained consistent from the start to the end of the reporting period (**Figure 10 – bottom**). Out of the 2,277 cases reported during this time, 84.8% were culture positive. Of the culture positive cases with AMR data, 10.6% of the isolates tested were resistant to at least one first-line antimicrobial treatment (excludes fluoroquinolone mono-resistance) (**Table 9**). The most common type of AMR identified in resistant isolates was isoniazid mono-resistance (58.9%), followed by multidrug resistance (12.3%) and pyrazinamide mono-resistance (11.9%) (**Table 9**). No isolates were identified as extensively resistant. A description of the AMR classification scheme for this report is available under the Antimicrobial Resistance Category Aggregation section. In Alberta, between 2013 and 2022, the median per cent of isolates that were resistant to at least one first-line antibiotic (excluding fluoroquinolone mono-resistance) was 9.9% (IQR: 3.0%, Range: 6.8 - 17.7%), which is similar to the national median per cent of 9.6% for the same time period (IQR: 0.9%, Range: 8.0 - 10.5%) [13]. The Alberta annual count of cases by resistance type can be found in **Appendix Table 4**.

AMR was most frequently identified in individuals born outside of Canada, accounting for 92.7% of AMR detections, followed by 6.4% for non-Indigenous Canadian-born individuals, and 1.0% for the remaining population groups. By age, AMR was most frequently identified in the 35 to 64 years age group (45.7%), followed by the 15 to 34 years (39.3%), the 65 years and over (13.7%) and the 5 to 14 years (1.4%). No AMR was detected in cases under 5 years of age.



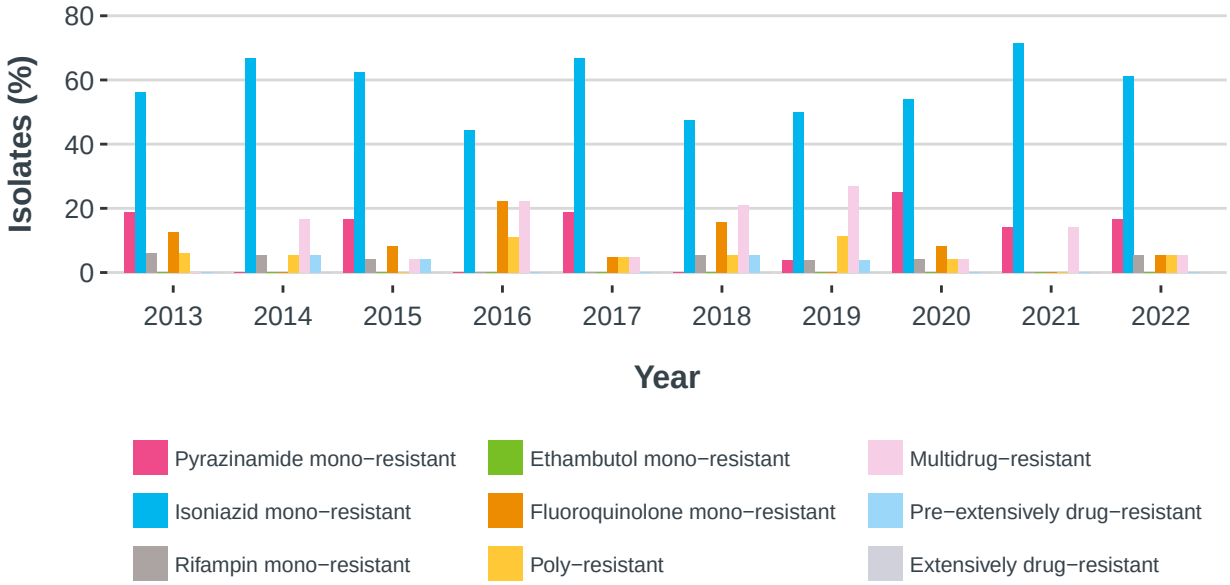


Figure 10. Per cent of TB isolates resistant to at least one first-line antimicrobial (*top*) and resistant TB isolates by drug resistance type, (*bottom*) by year (2013 - 2022)

Table 9. Count and per cent of TB cases by drug resistance type (2013 - 2022)

	Cases		
Resistance Category	Count	Per cent (all tested)	Per cent (AMR)
Fully susceptible	1709	88.6	-
First-line mono-resistant			
Pyrazinamide mono-resistant	26	1.3	11.9
Isoniazid mono-resistant	129	6.7	58.9
Rifampin mono-resistant	7	0.4	3.2
Ethambutol mono-resistant	0	0.0	0.0
Fluoroquinolone mono-resistant	15	0.8	6.8
Poly-resistant	11	0.6	5.0
Multidrug-resistant	27	1.4	12.3
Pre-extensively drug-resistant	4	0.2	1.8
Extensively drug-resistant	0	0.0	0.0

Note: A subset of cases, 1,930 out of 2,277, were culture positive. Of the culture positive cases, 2 had an unknown resistance type.

Outcomes and Mortality

In total, 88.5% of cases completed treatment between 2013 and 2021 (**Table 10**). Between 2013 and 2021, the median per cent of individuals who completed treatment was 88.0% (IQR: 3%, Range: 85.7 - 93.4%), which was higher than the national median of 81.3% (2012 to 2021) (IQR: 4.2%, Range: 75.3 - 84.3%) [13]. In Alberta, the most common reason for non-completion of treatment was death from any cause before or during treatment (42.3% of non-complete outcomes) and transfer of the case out of Canada for follow-up care (30.3% of non-complete outcomes) (**Table 11**). Treatment completion rates decreased with increasing age. For example, treatment completion rates were 96.7% and 100% for the under 5 years and 5 to 14 years age groups, respectively, but were lower for those 65 years and over (76.2%). A description of the aggregation of TB outcomes for this report can be found in the data notes section under TB Outcome Categories.

A total of 83 deaths were attributed to TB between 2013 and 2021 (by year of diagnosis) with an overall CFR of 4.1 deaths per 100 cases (**Table 12**). The Alberta median CFR was 3.8 deaths per 100 cases (IQR: 1.2 deaths per 100 cases, Range: 2.1 - 7.2 deaths per 100 cases), which was lower than the national median CFR (TB related) of 5.2 deaths per 100 cases (IQR: 0.6 deaths per 100 cases, Range: 3.6 - 6.5 deaths per 100 cases) [13]. Annual counts of cases by treatment outcomes and by mortality can be found in **Appendix Table 5** and **Appendix Table 6**, respectively.

Table 10. Count and per cent of TB cases by TB outcomes (2013 - 2021)

	Cases	
Treatment Outcomes	Count	Per cent (all outcomes)
Completed	1799	88.5
Ongoing	1	0.0
Transferred	71	3.5
Discontinued	15	0.7
Other	45	2.2
Death	99	4.9
Unknown	3	0.1
Total	**2033**	**100.0**

Note: Death includes all causes. Transferred cases are cases who have left Canada. These cases may have completed treatment after leaving the country.

Table 11. Count and per cent of TB cases by non completed TB outcomes (2013 - 2021)

	Cases	
Treatment Outcomes	Count	Per cent (non-completed outcomes)
Ongoing	1	0.4
Transferred	71	30.3
Discontinued	15	6.4
Other	45	19.2
Death	99	42.3
Unknown	3	1.3
Total	**234**	**100.0**

Note: Death includes all causes. Transferred cases are cases who have left Canada. These cases may have completed treatment after leaving the country.

Table 12. Count and per cent of total deaths and case fatality rate (CFR) of TB cases where TB caused or contributed to death (2013 - 2021)

Death*	Count	Per cent of Total Deaths	CFR (per 100 cases)
TB Contributed	34	41.0	1.7
TB Caused	49	59.0	2.4
Total TB Deaths	**83**	**100.0**	**4.1**

Note: Includes deaths that occurred before or during treatment. Deaths where TB was determined to not be a cause or contributing factor are excluded.

Conclusion

From 2013 to 2022, the rate of TB in Alberta was stable. The median TB rate over the 10-year period was higher in Alberta than the overall national TB rate [13]. However, Alberta had the lowest median rate when compared with other Western provinces (British Columbia, Saskatchewan and Manitoba) [13]. In 2022, the Alberta rate was 5.4 cases per 100,000 population. The WHO goals, endorsed by the Government of Canada, were 1.0 case per 100,000 population by 2035 and 0.1 cases per 100,000 population in 2050 [16]. Given that the 10-year trend is stable, action is needed to reduce the rate over the next ten years to achieve this goal.

Rates of TB in Alberta by sex and age group were also stable during this time and were highest among males and individuals 65 years and older, consistent with national trends [13]. Alberta performed well when compared with national indicators. For example, Alberta achieved a higher treatment completion rate and had a lower CFR when compared with national data.

The limited availability of population estimates for the different population groups makes it challenging to assess the progress toward TB elimination in Alberta. Most of the TB cases reported in Alberta are diagnosed among individuals born outside of Canada, which increased from 2013 to 2022. This increase may be due to changes in immigration patterns and population structure within Alberta.

Most TB isolates were fully susceptible to treatment and no clear trends in patterns of AMR were observed over time. Individuals born outside of Canada were more frequently infected with AMR TB when compared to Canadian-born individuals, which was also observed in national TB surveillance reporting [13]. The higher prevalence of AMR TB in the population of individuals born outside of Canada is logical when considering that the most common countries of birth have a higher prevalence of AMR TB, such as India and the Philippines [14]. Alberta has a higher percentage of AMR cases than the national percentage, which is likely associated with the higher percentage of TB cases in Alberta diagnosed in individuals born outside of Canada when compared to national data [13].

Respiratory TB was the most common primary diagnostic site among all cases. However, among individuals born outside of Canada, non-respiratory primary diagnostic sites were more common when compared to Canadian-born individuals. The increased number of non-respiratory sites of infection among individuals born outside of Canada is likely a result of current immigration screening practices, which focus on the screening and treatment of respiratory TB over non-respiratory TB [20]. As a result, individuals born outside of Canada with non-respiratory TB are more likely to be diagnosed after immigrating to Alberta. [20]. Most cases completed treatment and treatment completion rates remained stable over the reporting period. The annual CFR in Alberta was also consistent year-to-year and tended to be below the national CFR.

Improvements in Alberta surveillance data collection might provide a more comprehensive understanding of the epidemiology of TB. For example, it is challenging to determine which cases are connected to TB outbreaks because there are no data linkages. Similarly, there are no epidemiological links between TB cases. Since LTBI is not reportable in Alberta, it is also difficult to determine if an individual born outside of Canada contracted TB in Alberta or if the infection progressed from LTBI, acquired prior to immigrating to Canada, to an active TB infection. These data gaps limit understanding of TB transmission within Alberta and populations at high risk of TB acquisition within Alberta.

In summary, while Alberta is performing well relative to other Western provinces and when compared to some national metrics, there has been little progress toward TB elimination goals in the past decade. The increasing number of cases diagnosed in individuals born outside of Canada presents ongoing challenges. Diagnosis and treatment of this group is complicated by the increased number of non-respiratory and AMR TB cases. Alberta's strong performance on key TB reporting metrics provides a solid foundation for the implementation of new strategies to prevent, detect and treat TB. Adaptations to ongoing and emerging challenges are necessary for Alberta to continue progressing toward the goal of eliminating TB by 2050. Regular and ongoing surveillance will be key to assessing Alberta's progress toward this goal.

Data Notes

TB Outcome Categories

Outcomes are aggregated into broader categories for the purpose of this report.

- **Completed:** Includes the sub-categories of “Treatment Completed” and “Cured”
- **Ongoing:** Treatment is ongoing
- **Transferred:** Patient is transferred out of Canada for care
- **Discontinued:** Includes the sub-categories of “Treatment Failure”, “Absconded” and “Treatment Discontinued”
- **Death:** All cause, before or during treatment

Antimicrobial Resistance Categories

- **First-line mono-resistant TB**
  - resistance to one of the following first-line antibiotics: pyrazinamide, isoniazid, ethambutol or rifampin
- **Fluoroquinolone mono-resistant TB**
  - Resistance to one of the following fluoroquinolone antibiotics: ofloxacin, moxifloxacin or levofloxacin
- **Poly-resistant TB**
  - Resistance to at least two first-line antibiotics, except for isoniazid and rifampin simultaneously
- **Multidrug-resistant TB (MDR-TB)**
  - Resistance to isoniazid and rifampin simultaneously
- **Pre-extensively drug-resistant TB (pre-XDR TB)**
  - Resistance to isoniazid, rifampin and a fluoroquinolone OR
  - Resistance to isoniazid, rifampin and a second-line injectable antibiotic (amikacin, capreomycin or kanamycin)
- **Extensively drug-resistant TB (XDR-TB)**
  - Resistance to isoniazid, rifampin, a fluoroquinolone and a second-line injectable antibiotic OR
  - Resistance to isoniazid, rifampin, a fluoroquinolone and bedaquiline or linezolid

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- The Public Health Analytics Unit, Health Analytics Branch, Strategic Policy and Performance Division

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Data Appendix

Appendix Table 1. Count of TB cases by age group, sex, and year (2013 - 2022)

	Age Groups																			
	<5				5-14				15-34				35-64				65+			
Year	M	F	U	ALL	M	F	U	ALL	M	F	U	ALL	M	F	U	ALL	M	F	U	ALL
2013	4	2	0	6	5	4	0	9	25	39	0	64	44	33	0	77	21	11	0	32
2014	3	1	0	4	0	0	0	0	44	39	0	83	46	39	0	85	27	18	0	45
2015	3	2	0	5	1	6	0	7	32	39	0	71	54	35	0	89	19	19	0	38
2016	3	2	0	5	1	1	0	2	28	42	0	70	72	35	0	107	26	28	0	54
2017	1	1	0	2	2	2	0	4	30	35	0	65	47	47	0	94	38	21	0	59
2018	1	2	0	3	2	1	0	3	41	36	0	77	53	38	0	91	24	23	0	47
2019	0	1	0	1	1	1	0	2	43	30	0	73	76	39	0	115	29	23	0	52
2020	0	0	0	0	0	3	0	3	45	41	1	87	59	50	0	109	35	17	0	52
2021	2	2	0	4	1	2	0	3	41	36	0	77	54	54	0	108	26	23	0	49
2022	2	0	0	2	1	1	0	2	29	30	0	59	74	50	0	124	37	20	0	57

Appendix Table 2. Count and per cent of TB cases by population group and year (2013 - 2022)

	Population Group									
	First Nations		Individuals Born Outside Of Canada		Métis		Non-Indigenous Canadian-Born		Unknown	
Year	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
2013	12	6.4	160	85.1	4	2.1	12	6.4	0	0.0
2014	15	6.9	186	85.7	1	0.5	15	6.9	0	0.0
2015	12	5.7	182	86.7	1	0.5	15	7.1	0	0.0
2016	20	8.4	197	82.8	3	1.3	18	7.6	0	0.0
2017	9	4.0	198	88.4	4	1.8	13	5.8	0	0.0
2018	16	7.2	186	84.2	1	0.5	17	7.7	1	0.5
2019	14	5.8	221	90.9	2	0.8	5	2.1	1	0.4
2020	14	5.6	229	91.2	0	0.0	8	3.2	0	0.0
2021	11	4.6	216	89.6	1	0.4	13	5.4	0	0.0
2022	10	4.1	227	93.0	0	0.0	7	2.9	0	0.0

Appendix Table 3. Count and per cent of TB cases by HIV testing status and year (2013 - 2022)

	HIV Test Status									
	Positive		Negative		Refused		Not Offered		Unknown	
Year	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
2013	7	3.7	179	95.2	2	1.1	0	0.0	0	0.0
2014	13	6.0	200	92.2	3	1.4	1	0.5	0	0.0
2015	5	2.4	200	95.2	4	1.9	1	0.5	0	0.0
2016	7	2.9	228	95.8	1	0.4	2	0.8	0	0.0
2017	6	2.7	213	95.1	0	0.0	2	0.9	3	1.3
2018	5	2.3	213	96.4	0	0.0	1	0.5	2	0.9
2019	5	2.1	232	95.5	0	0.0	4	1.6	2	0.8
2020	5	2.0	236	94.0	0	0.0	3	1.2	7	2.8
2021	4	1.7	236	97.9	0	0.0	0	0.0	1	0.4
2022	1	0.4	242	99.2	0	0.0	0	0.0	1	0.4

Appendix Table 4. Count and per cent of TB cases by antimicrobial resistance type and year (2013 - 2022)

	Mono-resistant										Multi-resistant							
	Pyrazinamide		Isoniazid		Rifampin		Ethambutol		Fluoroquinolone		Poly -resistant		MDR TB		Pre-XDR TB		XDR-TB	
Year	n	Per cent	n	Per cent	n	Per cent	n	Per cent	n	Per cent	n	Per cent	n	Per cent	n	Per cent	n	Per cent
2013	3	18.8	9	56.2	1	6.2	0	0	2	12.5	1	6.2	0	0.0	0	0.0	0	0
2014	0	0.0	12	66.7	1	5.6	0	0	0	0.0	1	5.6	3	16.7	1	5.6	0	0
2015	4	16.7	15	62.5	1	4.2	0	0	2	8.3	0	0.0	1	4.2	1	4.2	0	0
2016	0	0.0	8	44.4	0	0.0	0	0	4	22.2	2	11.1	4	22.2	0	0.0	0	0
2017	4	19.0	14	66.7	0	0.0	0	0	1	4.8	1	4.8	1	4.8	0	0.0	0	0
2018	0	0.0	9	47.4	1	5.3	0	0	3	15.8	1	5.3	4	21.1	1	5.3	0	0
2019	1	3.8	13	50.0	1	3.8	0	0	0	0.0	3	11.5	7	26.9	1	3.8	0	0
2020	6	25.0	13	54.2	1	4.2	0	0	2	8.3	1	4.2	1	4.2	0	0.0	0	0
2021	5	14.3	25	71.4	0	0.0	0	0	0	0.0	0	0.0	5	14.3	0	0.0	0	0
2022	3	16.7	11	61.1	1	5.6	0	0	1	5.6	1	5.6	1	5.6	0	0.0	0	0

Note: A subset of cases, 1,930 out of 2,277, were culture positive. Of the culture positive cases, 2 had an unknown resistance type.

Appendix Table 5. Count and per cent of TB cases by treatment outcomes (2013 - 2021)

	Treatment Outcome													
	Completed		Ongoing		Transferred		Discontinued		Other		Death		Unknown	
Year	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent	Count	Per cent
2013	173	92.0	0	0.0	4	2.1	0	0.0	5	2.7	6	3.2	0	0.0
2014	194	89.4	0	0.0	9	4.1	0	0.0	8	3.7	6	2.8	0	0.0
2015	185	88.1	0	0.0	6	2.9	3	1.4	5	2.4	11	5.2	0	0.0
2016	208	87.4	0	0.0	13	5.5	1	0.4	4	1.7	12	5.0	0	0.0
2017	192	85.7	1	0.4	7	3.1	3	1.3	9	4.0	11	4.9	1	0.4
2018	191	86.4	0	0.0	11	5.0	2	0.9	5	2.3	12	5.4	0	0.0
2019	210	86.4	0	0.0	12	4.9	4	1.6	3	1.2	13	5.3	1	0.4
2020	221	88.0	0	0.0	9	3.6	2	0.8	0	0.0	18	7.2	1	0.4
2021	225	93.4	0	0.0	0	0.0	0	0.0	6	2.5	10	4.1	0	0.0

Appendix Table 6. Count and case fatality rate (CFR) (deaths per 100 cases) of deaths due to TB by year of diagnosis (2013 - 2021)

	Deaths due to TB				
Year	Caused	Contributed	Total	Total annual cases	CFR (per 100 cases)
2013	2	2	4	188	2.1
2014	2	3	5	217	2.3
2015	4	4	8	210	3.8
2016	7	3	10	238	4.2
2017	6	4	10	224	4.5
2018	6	5	11	221	5.0
2019	6	3	9	243	3.7
2020	12	6	18	251	7.2
2021	4	4	8	241	3.3
Total	**49**	**34**	**83**	**2033**	**4.1**